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ROOM NO.	BUILDING	
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cc: <input type="text"/>		OSWR
FROM: Harry Rowen, C/NIC		
ROOM NO.	BUILDING	EXTENSION
7E62	Hqs.	<input type="text"/>

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OFFICE OF THE  
COMMISSIONER

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

February 17, 1983

NOTE FOR HARRY ROWEN

I've enclosed a report I had prepared on enrichment deliveries to European reactors. So far as I can tell, it contains new information in that previous reports dealt with contracts as opposed to actual deliveries.

I thought you'd find the Soviet contribution especially interesting (the enrichment "pipeline"). The report shows the Western Europeans -- especially the Germans and Italians -- shifted to the Soviets about the time when arguments over MB-10's reprocessing and export policy were taking place.

Enclosure

STAT

# **HISTORICAL DELIVERIES OF ENRICHMENT SERVICES TO COMMERCIAL POWER REACTORS**

**Final Report  
January 1983**



STAT

**Nuclear Assurance Corporation**

**Prepared for  
U. S. Nuclear Regulatory Commission**

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ENRICHMENT SERVICES TO COMMERCIAL POWER REACTORS**

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SECTION I  
**EXECUTIVE SUMMARY**

Six Western European countries were examined to provide annual enrichment market shares by supplier for the years 1975 through 1981. Each country analyzed had achieved commercial nuclear power by 1975, with four countries, Germany, France, Italy, and Spain, operating commercial reactors in the 1960s. The United States supplied these countries with all of their required low enriched uranium until the following years:

- Germany - 1974
- Italy - 1975
- France - 1977
- Spain - 1978
- Belgium - 1979
- Sweden - 1979

In each country, this U.S. supply was subsequently joined by supply from the USSR. These two suppliers held each market, nearly evenly matched in many cases, until 1979 when France received EURODIF enriched material. In 1980 three other countries, Belgium, Italy, and Spain received EURODIF supply. Germany received EURODIF enriched material for the first time in 1981, and Sweden has yet to sign a EURODIF contract.

With the introduction of EURODIF supply, U.S. and USSR market shares decreased in all countries but Sweden. In Italy the USSR retained a substantial market share even with EURODIF supply, due in part to the U.S. ceasing to deliver after 1979. Four out of the six countries have been participants in EURODIF since 1972 and therefore were committed to take a designated portion of that production annually, once EURODIF was in operation.

Germany, on the other hand, has been a shareholder in another enrichment organization, Urenco, but did not begin to withdraw material from that source until 1982. The USSR, rather than DOE, held the majority of the German market in four out of the last five years examined, due partly to German cancellation

of U.S. Department of Energy (DOE) contracts in order to support eventual Urenco deliveries. In no other country evaluated was Urenco a supplier.

Because of the introduction of USSR and EURODIF supply, the U.S. market share dropped substantially. The following breakdown by country shows the U.S. DOE market share in 1975 and 1981:

	1975 <u>(Percent)</u>	1981 <u>(Percent)</u>
● Belgium	100	26
● Germany	81	41
● France	100	5
● Italy	62	0
● Spain	100	11
● Sweden	100	76

Only in Sweden does the U.S. maintain the majority market share. In the five other countries, with the exception of Germany, EURODIF had picked up over 50 percent of the total market by 1981.

SECTION II  
**INTRODUCTION**

The purpose of this report is to provide information on deliveries of low enriched uranium by supplier to commercial nuclear power reactors in six Western European countries:

- Belgium
- Federal Republic of Germany
- France
- Italy
- Spain
- Sweden

These deliveries were examined for the years 1975 through 1981, inclusively. Each country was evaluated in terms of all suppliers producing enriched uranium during this time. In Section III the results are presented in bar graph and tabular form. The total annual numerical quantity for each appropriate supplier, as well as that supplier's resulting annual market share, is given for each country. This delivery information is based on actual enriched uranium withdrawals to individual reactors as well as bulk deliveries to utilities or government organizations for use in commercial power plants.

SECTION III

**COUNTRY EVALUATIONS**

## BELGIUM

The three commercial reactors in Belgium's nuclear power program began operation in 1975. At that time the U.S. supplied all of the needed enrichment services to these reactors. This 100 percent market share was maintained through 1978. The USSR began to deliver enriched uranium to Belgium in 1979 and was joined by EURODIF in 1980. Belgium's relationship with EURODIF goes back to 1972 when the country became a founding shareholder in the enrichment consortium. Because of its 11.11 percent ownership in EURODIF, Belgium was obligated to take a portion of EURODIF production. By 1981 EURODIF had a 57 percent market share in Belgium, with U.S. supply dwindling to 26 percent and USSR to 17 percent.

TABLE III.1

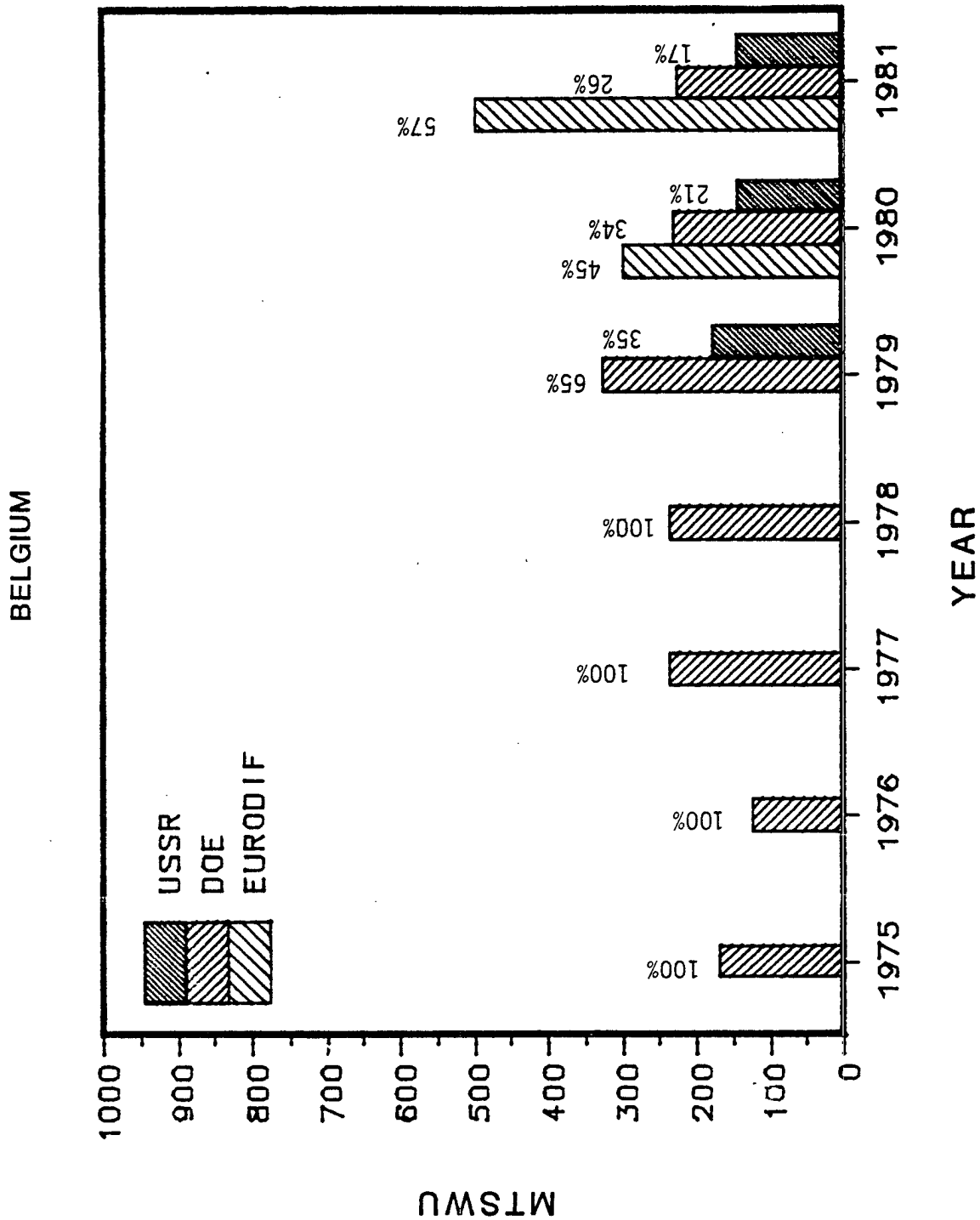
ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS AND SUPPLIER MARKET SHARE: BELGIUM  
(MTSWU)

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January 1983

SUPPLIER	1975		1976		1977		1978		1979		1980		1981	
	(MTSWU)	% (of Market)	(MTSWU)	% (of Market)	(MTSWU)	% (of Market)	(MTSWU)	% (of Market)	(MTSWU)	% (of Market)	(MTSWU)	% (of Market)	(MTSWU)	% (of Market)
U.S. DOE	169	100	124	100	237	100	237	100	326	65	229	34	226	26
EURODIF	-	0	-	0	-	0	-	0	-	0	300	45	500	57
USSR	-	0	-	0	-	0	-	0	177	35	144	21	144	17
URENCO	-	0	-	0	-	0	-	0	-	0	-	0	-	0

FIGURE III.1  
ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS  
BY SUPPLIER





FEDERAL REPUBLIC OF GERMANY

Germany has been operating commercial nuclear power plants since 1962. The U.S. was the only supplier of enrichment services to Germany until 1974 when the USSR began delivering enriched uranium. Until 1981 the U.S. and the USSR had relatively equal market shares. In 1981 EURODIF began delivering small amounts of enriched uranium under its one contract with a German utility. Though Germany was a founding participant in the enricher organization, Urenco, since 1971, the initial Urenco deliveries of enriched uranium were not made to Germany until 1982.

TABLE III.2

ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS AND SUPPLIER MARKET SHARE: FEDERAL REPUBLIC OF GERMANY  
(MTSWU)

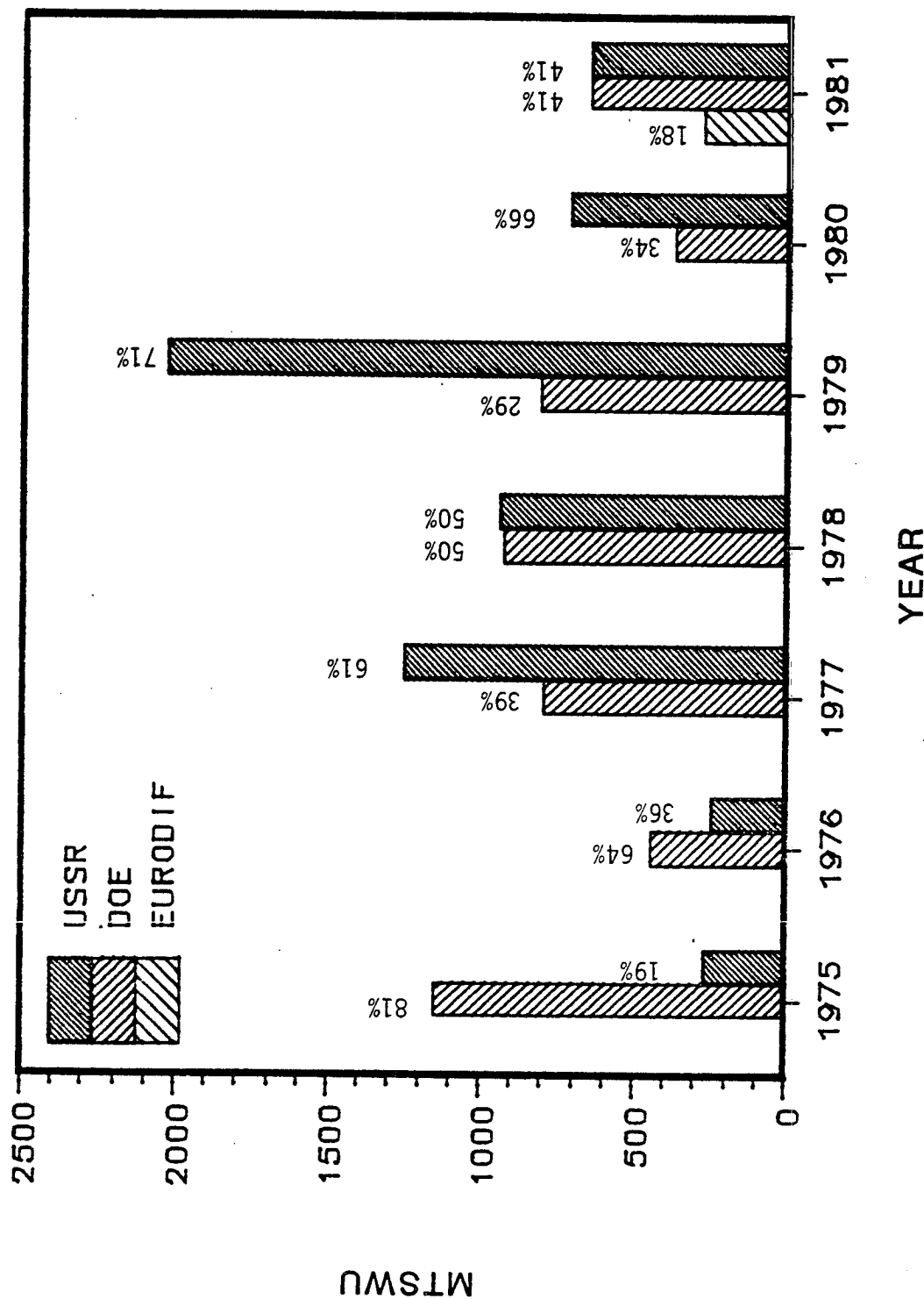
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January 1983

SUPPLIER	1975		1976		1977		1978		1979		1980		1981	
	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %
U.S. DOE	1,146	81	444	64	794	39	933	50	811	29	373	34	654	41
EURODIF	-	0	-	0	-	0	-	0	-	0	-	0	284	18
USSR	270	19	249	36	1,257	61	943	50	2,035	71	716	66	657	41
URENCO	-	0	-	0	-	0	-	0	-	0	-	0	-	0

FIGURE III.2  
ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS  
BY SUPPLIER

FEDERAL REPUBLIC OF GERMANY



## FRANCE

Until 1971, the French commercial nuclear power program was based on Magnox-type reactors that required no enrichment services. With the program change to Pressurized Water Reactors (PWR) leading to commercial operation of the first PWR, Sena Chooz, in 1971, enrichment of uranium was needed and obtained from the U.S. The U.S. was the only supplier to the French commercial nuclear program until 1977 when the USSR began shipping enriched uranium to France. For the years 1977 and 1978 the U.S. and the USSR maintained essentially equal market shares. Starting in 1979 France began receiving over half of its enrichment services from EURODIF. France has been a majority partner in the enrichment consortium initially with a 42.78 percent share, subsequently increasing this share to 51.5 percent. Because of this major shareholding, France took over three-fourths of its enriched uranium deliveries from EURODIF by 1980.

TABLE 111.3

ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS AND SUPPLIER MARKET SHARE: FRANCE  
(MTSWU)

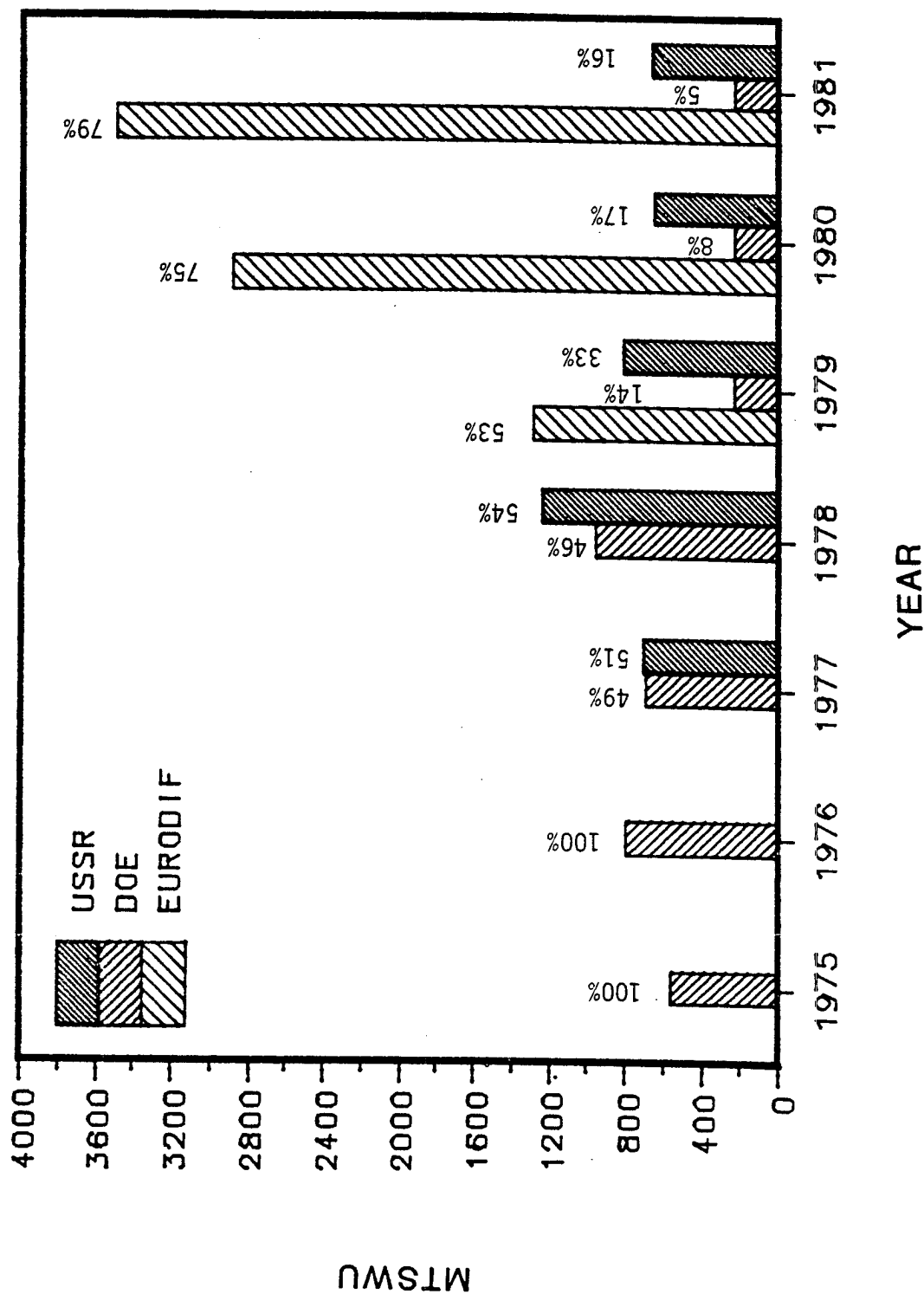
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January 1983

SUPPLIER	1975		1976		1977		1978		1979		1980		1981	
	(MTSWU)	(% of Market)	(MTSWU)	(% of Market)	(MTSWU)	(% of Market)	(MTSWU)	(% of Market)	(MTSWU)	(% of Market)	(MTSWU)	(% of Market)	(MTSWU)	(% of Market)
U.S. DOE	564	100	804	100	693	49	1,051	46	329	14	319	8	239	5
EURODIF	-	0	-	0	-	0	-	0	1,300	53	2,900	75	3,500	79
USSR	-	0	-	0	715	51	1,250	54	820	33	665	17	680	16
URENCO	-	0	-	0	-	0	-	0	-	0	-	0	-	0

FIGURE III.3  
ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS  
BY SUPPLIER

FRANCE



## ITALY

Italy has operated a small program of commercial reactors since 1964. The U.S. alone supplied enrichment services for these reactors until it was joined in 1975 by supply from the USSR. From 1977 until 1980 the USSR was Italy's primary source of enriched uranium. In 1981 supply was almost evenly matched between the USSR and EURODIF while during the 1980-81 period, the U.S. ceased to send any further enriched uranium to Italy. Italy joined Belgium, France, and Spain as a partner in the enrichment organization, EURODIF, with a 25 percent shareholding. This proportion has since decreased to 16.25 percent. By the end of 1981, EURODIF held a 54 percent market share in Italian enrichment withdrawals.

TABLE 111.4

ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS AND SUPPLIER MARKET SHARE: ITALY  
(MTSWU)

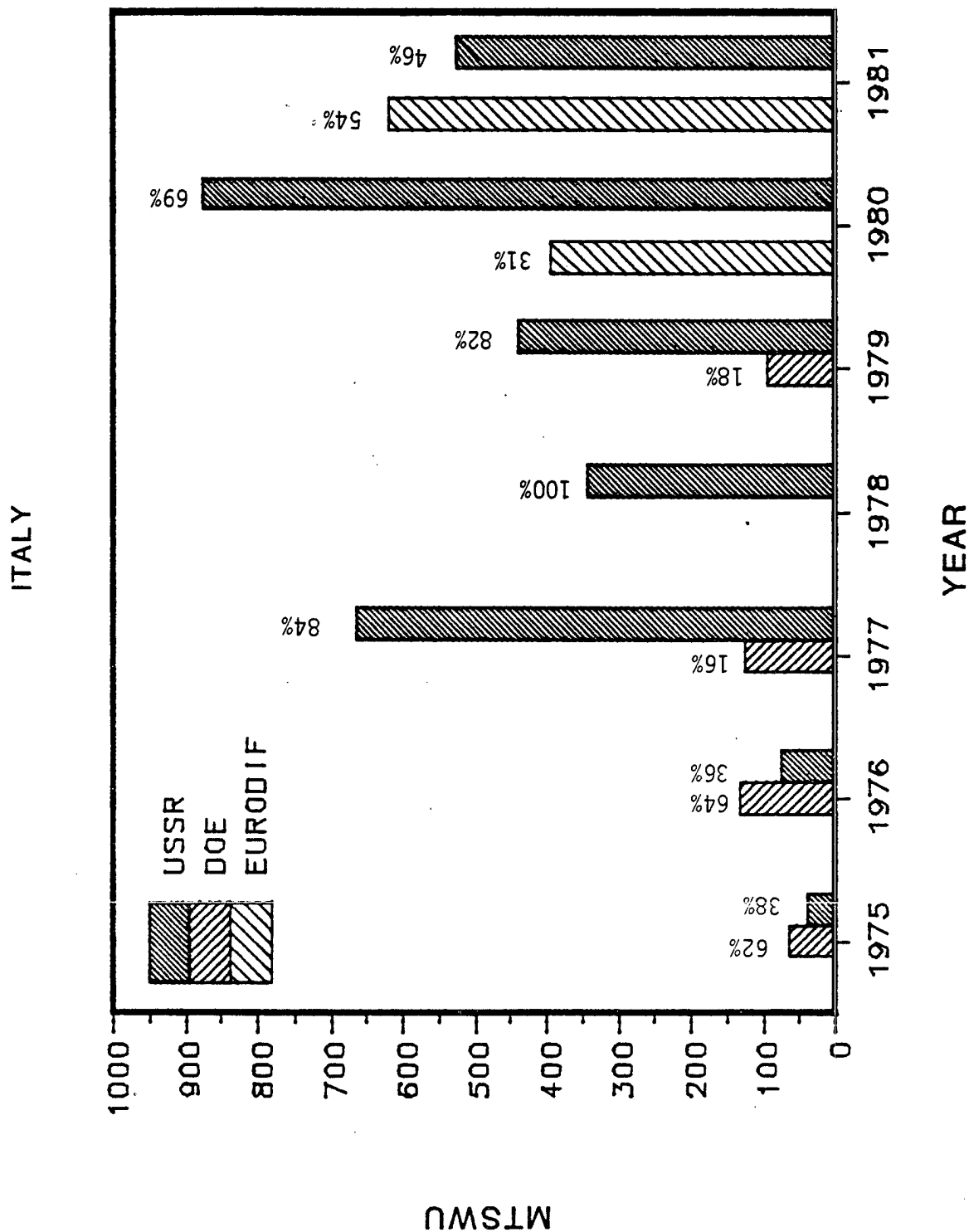
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January 1983

SUPPLIER	1975		1976		1977		1978		1979		1980		1981	
	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %
U.S. DOE	66	62	133	64	128	16	-	0	95	18	-	0	-	0
EURODIF	-	0	-	0	-	0	-	0	-	0	393	31	620	54
USSR	40	38	75	36	665	84	343	100	439	82	877	69	528	46
URENCO	-	0	-	0	-	0	-	0	-	0	-	0	-	0



FIGURE III.4  
ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS  
BY SUPPLIER



## SPAIN

Spain began generating commercial nuclear power in 1969. As with the preceding countries, the U.S. initially held 100 percent of the enrichment market for Spanish reactors. This lasted until 1978 when supply from the USSR began. A 75-25 percent share of the market existed between the U.S. and the USSR, respectively, until EURODIF began delivering enriched uranium in 1980. By this time the U.S. portion dwindled to less than 15 percent of all withdrawals. Spain is also a partner in EURODIF with an 11.11 percent participation. As with Belgium, France, and Italy, by 1981 EURODIF withdrawals were amounting to over half of all withdrawals received.

TABLE III.5

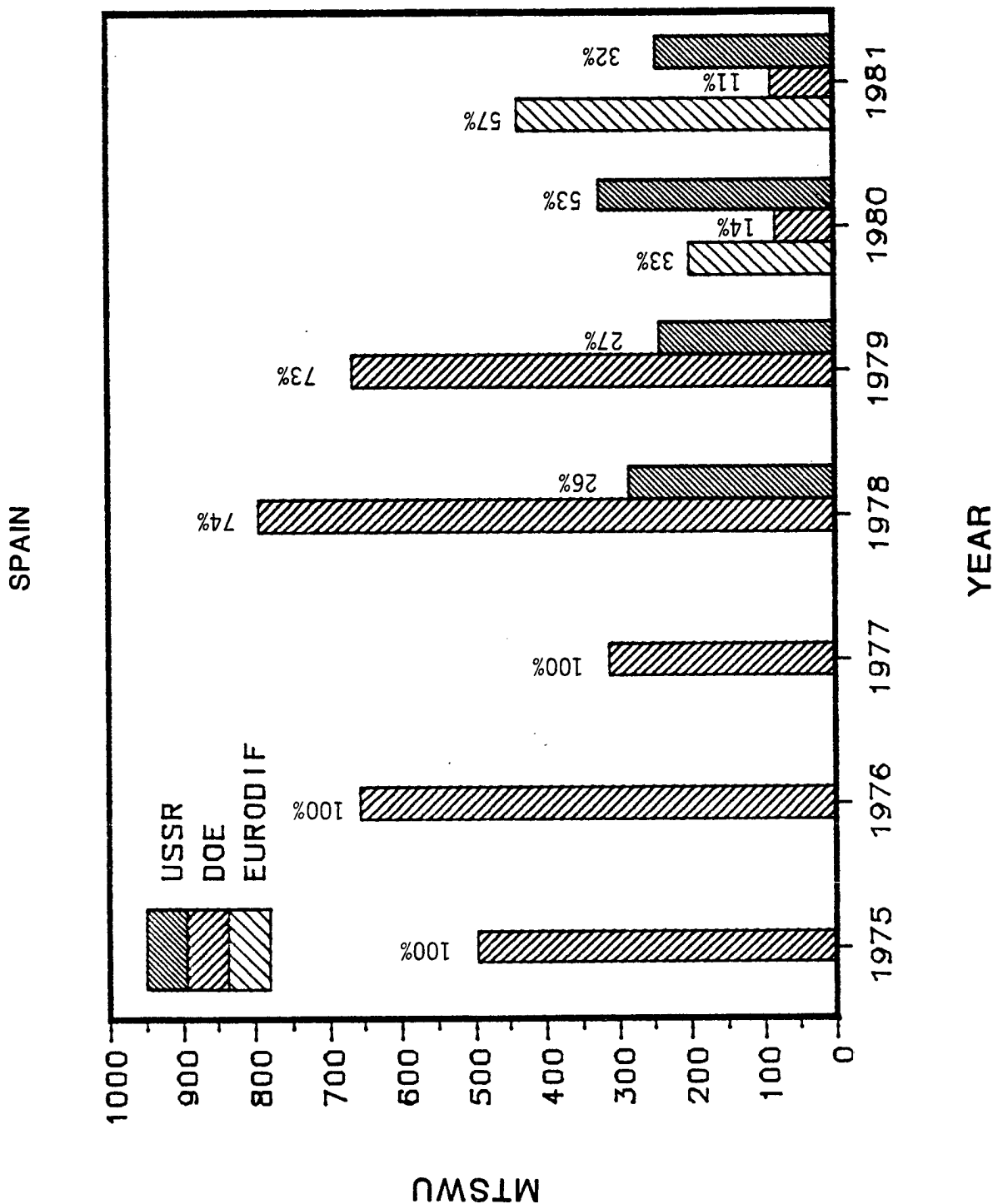
ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS AND SUPPLIER MARKET SHARE: SPAIN  
(MTSWU)

FUEL-TRAC®

January 1983

SUPPLIER	1975		1976		1977		1978		1979		1980		1981	
	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %
U.S. DOE	496	100	655	100	313	100	794	74	665	73	82	14	86	11
EURODIF	-	0	-	0	-	0	-	0	-	0	201	33	437	57
USSR	-	0	-	0	-	0	284	26	243	27	324	53	245	32
URENCO	-	0	-	0	-	0	-	0	-	0	-	0	-	0

FIGURE III.5  
ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS  
BY SUPPLIER



## SWEDEN

Sweden has had commercial nuclear power since 1972. From then until 1979, this country used entirely U.S.-enriched uranium in its reactors. From 1979 through 1981 the U.S. was still the primary supplier to Sweden. The USSR delivered, in 1979 and 1981, enough enriched material for a first core and one reload. Sweden is not a participant of any enrichment organization, unlike the other countries analyzed. It is entirely dependent on foreign supply.

TABLE III.6

ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS AND SUPPLIER MARKET SHARE: SWEDEN  
(MTSWU)

FUEL-TRAC®

January 1983

SUPPLIER	1975		1976		1977		1978		1979		1980		1981	
	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %	(MTSWU)	(of Market) %
U.S. DOE	244	100	825	100	696	100	857	100	667	69	444	100	389	76
EURODIF	-	0	-	0	-	0	-	0	-	0	-	0	-	0
USSR	-	0	-	0	-	0	-	0	300	31	-	0	123	24
URENCO	-	0	-	0	-	0	-	0	-	0	-	0	-	0

FIGURE III.6  
ANNUAL HISTORICAL ENRICHMENT WITHDRAWALS  
BY SUPPLIER

SWEDEN

